DOCUMENT RESUME

ED 157 299 EC 111 784

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TITLE Programming Educational Environments for the Severely Retarded: Curriculum Development, Research and Service, Emanating from an Errorless Learning Model.
PUB DATE Jun 78
NOTE 19p.; Paper presented at the World Congress on Future Special Education (First, Stirling, Scotland, June 25 - July 1, 1978)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Curriculum Development; *Custodial Mentally Handicapped; Early Childhood Education; *Educational Technology; Elementary Secondary Education; Mentally Handicapped; Severely Handicapped; *Trainable Mentally Handicapped

ABSTRACT

The paper describes a 6-year project to develop curriculum, instructional technology, and computer generated instruction for severely developmentally retarded children (1 to 21 years old). Sections focus on curriculum content (which includes 100 instructional programs in such areas as self help skills), curriculum structure, the integrated learning system, instructional model, and field validation. A view of the educational environments for severely impaired children in the year 2000 is presented, encompassing the concepts of efficient and futuristic uses of computer technology in homes and in schools. (Author/SBH)

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Programming Educational Environments for the Severely Retarded: Curriculum development, research and service, emanating from an errorless learning model

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Panel 19

The Future of Education of the Severely and Profoundly Retarded Child Through Organization of Facilities and Curriculum and the Rehabilitation Process

WORLD CONGRESS ON FUTURE SPECIAL EDUCATION

Stirling, Scotland

June 27, 1978

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Abstract

A six year project to develop curriculum, instructional technology and computer generated instruction will be described. Funded by the Bureau of Education for the Handicapped to meet the court mandated need for public education classes for the severely retarded, this project, Programmed Environments for the Developmentally Retarded, has developed an interrelated set of products. Here, a curriculum, and the research on its effectiveness will be presented. A view of the educational environments for severely impaired children in the year 2000 will be presented, encompassing the concepts of efficient and futuristic uses of computer technology in homes and in schools.

Programming Educational Environments for the Severely Retarded:
Curriculum development, research and service,
emanating from an errorless learning model

In the United States, the year 1971 marks the impetus for public education services for the severely developmentally retarded. Since 1972, my associates and I have been involved in a project, funded by the Research Project Branch of the Bureau for the Education of the Handicapped, to develop materials, methodologies and nontraditional models to educate this child population. During these six years, we have developed:

1. a curriculum for use by teachers
2. teacher training materials and proced res
3. data systems for classroom use
4. systems for competency based teacher evaluation
5. a system of computer-controlled instruction, including hardware, software and stimulus (curriculum) materials
6. a program of applied learning studies.

From 1974-1977, we were also engaged in a project to extend our computer instruction systems into homes across the state of Kentucky, to educate severely developmentally retarded children in their homes in remote or isolated areas.

Our present research and development efforts are drawing to a close, and it was my intent to summarize our findings in each area. Within these

twenty minutes, however, I will focus on the curriculum and our procedures for validating it. To do so will allow me to present child performance data and describe the conditions under which it was collected. This will also allow me to describe our teacher training strategy, and thus accomplish two goals at once. For, having documented the extent to which severely developmentally retarded children learn with these methodologies and materials, we will undoubtedly be questioned on the correspondence between our validation conditions and "actual classroom practice." My basic premise, then, is that these are necessary conditions for instruction, and indicate the direction which teacher training efforts should take, to document that instruction has occurred, and the extent to which it has been successful. Without such data, continued development of educational services is surely to be impaired.

Curriculum Content

The curriculum consists of approximately one hundred instructional programs which teach behaviors considered important for very young children. These programs include:

1. social skill development
2. language development
3. discrimination and concept learning
4. motor skills
5. self-help skills in the areas of eating, dressing and grooming.

For reference purposes, these skills have been indexed in a developmental

profile, typically covering behaviors which emerge birth to four years of age. The curriculum has been validated with children ranging in age from one to twenty years.

The most basic behaviors include response shaping and attending. Social skill development includes responding to social stimulation, making choices, using gestures to indicate preferences, sitting during an activity, playing independently, exchanging objects on cue, and playing with peers. Language behaviors begin with attending to voice and making sounds, and progress to object identification and use of yes-no. Copies of the profile are included in the handout packet.

Certain of the programs are designated as cycle programs, indicating that a class of items can be taught with the same program. Identifying easily handled objects can be used to teach a motor discrimination of small manipulable objects, e.g., toys, kitchen utensils, clothes, etc.

Curriculum Structure

The major characteristic of the instructional programs is that they are highly structured. While there are variations, the majority of programs include:

1. a rationale which states why a program is used, e.g., the concept it teaches and its function
2. the general goal of the program
3. definitions of terms used
4. the prerequisite skills S's are presumed to need to complete the program

5. the arrangement of materials

6. a list of materials needed for each step in the program

7. steps of increasing complexity, in the instructional sequence

8. pre-posttesting procedures

9. the instructional strategy which includes:

   (a) the setting events or arrangement

   (b) the task request

   (c) the observable behavior to be emitted

   (d) the latency between the request and the end of the trial, if no behavior is emitted

   (e) the criterion for success on each trial, and for progressing to the next step

10. suggested modifications, for children who do not progress

11. adaptations for children with motor or sensory impairments. Reinforcement and correction procedures are taught in the training program.

The curriculum is supplemented with a series of charts, indicating the range of behaviors or concepts which may be taught with specific programs. These also include extensions or generalization activities which expand content usage. The curriculum is considered to be generative in that the teacher who uses the curriculum model, task analysis, and instructional procedures specified in the training package, can generate her own curriculum sequences. Finally, the modifications and decision points described in the curriculum provide the teacher with a decision model, a framework within which to

modify programs if children experience difficulty.

The Integrated Learning System

During the course of this project, minor terminology changes have occurred, reflecting major shifts in conceptualization. We began the project, with the use of the term developmental retardation, after Bijou's behavioral formulation. We ceased talking about classrooms, in favor of learning environments since the former is not necessarily reflective of the latter. And, in lieu of curriculum development, we have most recently begun to use the term integrated learning system to reflect our interest in the development of curriculum, teaching procedures, data storage systems, and educational planning strategies, as well as our interest in recording data on teacher and child behavior.

The Instructional Model

Our computer, and teacher instruction systems are based on an errorless learning model. The term is derived from discrimination learning studies of human and infrahuman species, utilizing gradual vs abrupt shifts in stimulus dimensions to study the effects of learning with and without errors. Many, e.g., Bijou, Jeffrey, Moore and Goldiamond, Tawney, Terrace and Touchette have reported such studies. Sidman and Stoddard (1966) described an elaborate instructional errorless learning program designated to teach an adult retardate a difficult circle-ellipse discrimination. Their procedures guided the development of the automated instruction and served as a model for the

teacher use curriculum.

The meaning of the term errorless learning has broadened with our usage. Tawney (1977a) reported a task analysis of the Sidman and Stoddard procedures. The critical elements are appended (and included in the hand-out packet). They include careful assessment of the S's repertoire, fine grain task analysis of discrimination, identification of reinforcers, intensive programming with defined reinforcement or correction procedures. There are obvious parallels with good teaching behavior, assessment, instruction and remediation.

Errorless learning represents, also, a goal and statement of philosophy for us. That is, we expect our students, and teachers, to perform in an errorfree manner and accept it as our responsibility when they do not. This reflects a positive view of the learning behavior, of students and teachers, when conditions are structured to facilitate skill acquisition.

Field Validation

Objective

The purpose of field validation is to document the extent to which many, children will learn skills, concepts, and language when presented with our instructional programs and methodology. This data, collected over two years, in four states, will also tell us something about the academic capabilities of these students.

The Preliminary Curriculum Development Process

Instructional programs were written, used daily with one or two students, and revised until students demonstrated a high level of correct responding. Initial program writing was done at our project headquarters in Lexington where, in cooperation with the local Association for Retarded Children, a preschool for severely developmentally retarded children is operated. Project staff and teaching staff interact with students and each other in this program development process.

During the 1975-76 academic year, a pilot field validation effort was begun in a major city outside of Kentucky. Full scale validation was begun in 1976, and continues through this month (June, 1978).

Field Validation Procedures

Field validation requires an intensive teacher training and on-site monitoring effort. A trainer, who serves a function equivalent to a system supervisor and a project data collector is located at each site. These trainers attend an intensive training session in Lexington, then train teachers at their sites, with assistance from project staff, during the beginning of the academic term.

Teachers are trained to criterion on content presented in a series of instructional modules. Then they must demonstrate criterion performance, with their students, on instructional procedures, e. g., pre-posttesting, reinforcement, correction, data collection. When they have met the criterion, they may use as many of the programs as are appropriate for their students, and are required to use approximately nine programs during the academic

year. After they have begun regular program implementation, the field trainer visits their class regularly to provide technical assistance, and to observe and record their program administration skills. A project field coordinator visits each site periodically to provide technical assistance, and to conduct reliability checks with the field trainer. Child performance data is collected daily and transmitted to the project where it is entered into computer storage. Teacher performance data is collected regularly and is stored in a similar manner. Our procedures are summarized in Table I.

Table I

Procedures to Insure Adherence to Field Validation Conditions, and their Rationale

We want to:	So we:
1. insure teachers know the content, structure of programs, how to implement them and use them for long term programming	1. (a) present content in self-paced modules (b) post-test - and remediate - to 90% criterion
2. insure teachers use instructional procedures accurately, including program modifications	2. (a) present simulations (b) record teacher behavior (c) train and remediate to 90% criterion
3. insure regular program usage	3. (a) use special data sheets (b) utilize field trainers to confirm regular use
4. insure children respond to criterion	4. require response by response data collection or an equivalent measure
5. insure that teachers maintain criterion on instructional procedures	5. utilize a field trainer to: (a) visit regularly (b) observe and record data (c) remediate
6. insure teachers record data accurately	6. same as above
7. insure field trainers record data reliably	7. (a) provide intensive training (b) conduct reliability checks
8. modify programs based on child performance data	8. analyze performance and error patterns and teacher program modifications
9. modify programs based on teacher observations and feedback	9. analyze collected teacher comments on instructional programs

Outcomes

Scope of Training

Table 2

Number of Teachers in Field Validation

Years	Number of Teachers
1976-1977	42
1977-1978	71

Table 3

Number of Students in Field Validation

Years	Number of Students
1976-1977	182
1977-1978	93

Tables two and three indicate the scope of the training effort. Because this child population is low and heterogeneous in functional abilities, we have gone to cities of sufficient size to guarantee a large number of potential students.

Table 4

Percent Correct Responding Data
1976 - 1977

SITE(S) ALL

PROGRAM NAME	AVG %-CORRECT	POPULATION(N)	RANGE
RESPONDING TO STIMULATION-A	82	1	82 - 82
MAKING CHOICES	90.50	2	84 - 97
USING GESTURES TO INDICATE WANTS	93.25	4	89 - 100
INITIATING PLAY-ON-CUE	84	1	84 - 84
PLAYING INDEPENDENTLY	90	2	87 - 93
EXCHANGING OBJECTS ON CUE	94.33	3	93 - 95
PLAYING WITH PEERS	90	2	90 - 90
ATTENDING TO VOICE	88	15	74 - 100
FOLLOWING SIMPLE CUED COMMANDS	93.53	13	80 - 100
IDENTIFYING EASILY-HANDLED-OBJECTS	92.78	19	79 - 100
ATTENDING TO OWN NAME	86	1	86 - 86
IDENTIFYING LARGE OBJECTS	96	2	96 - 96
IDENTIFYING PEOPLE	97.25	4	93 - 100
SHAPING WORDS	89.20	10	75 - 100
USING YES-NO:LEVEL A	97	2	96 - 98
USING YES-NO:LEVEL B	96.66	3	96 - 97
ATTENDING TO OBJECTS	91.53	13	81 - 100
FINDING HIDDEN OBJECTS	86.75	20	68 - 100
IMITATING ACTIONS WITH OBJECTS	96	1	96 - 96
ATTENDING TO DEMONSTRATIONS	100	1	100 - 100
MATCHING (LEVEL A-OBJECTS)	87	3	84 - 89
IDENTIFYING SOURCE OF SOUND	94.16	6	89 - 100
PUTTING OBJECTS IN SEQUENCE	90.20	10	72 - 100
LINING UP OBJECTS	87.23	17	75 - 100
SORTING	97.75	4	91 - 100
IDENTIFYING SIMPLE PICTURES	100	1	100 - 100
LINING UP EQUAL SETS	92.55	20	63 - 100
SELECTING EQUIVALENT AMOUNTS	89.54	11	79 - 100
MAKING SETS EQUAL	92.25	4	71 - 94
MATCHING EQUAL SETS-LEVEL 1	95.85	7	89 - 100
MATCHING EQUAL SETS-LEVEL 2	100	4	100 - 100
MATCHING EQUAL SETS-LEVEL 3	100	2	100 - 100
MATCHING EQUAL SETS-LEVEL 4	90.50	2	84 - 97
COUNTING RATIONALLY-1	98	2	96 - 100
COUNTING RATIONALLY-2	50	2	1 - 100
COUNTING RATIONALLY-3	100	2	100 - 100
COUNTING RATIONALLY-4	100	2	100 - 100
COUNTING RATIONALLY-5	100	1	100 - 100
USING OBJECTS ON CUE	98	1	98 - 98

Table 5

Percent Correct Responding Data
1977 - 1978

SITE(S): ALL
YEAR: 1977-78
TODAY'S DATE: 2 JUN 78

PROGRAM NAME	AVG %-CORRECT	POPULATION(N)	RANGE
MAKING CHOICES	100	2	100 - 100
USING GESTURES TO INDICATE WANTS	88.25	4	78 - 97
SITTING DURING ACTIVITY	95	1	95 - 95
INITIATING PLAY ON CUE	86	1	86 - 86
EXCHANGING OBJECTS ON CUE	88	1	88 - 88
ATTENDING TO VOICE	79.50	6	65 - 90
FOLLOWING SIMPLE CUED COMMANDS	91.56	39	66 - 100
ATTENDING TO OWN NAME	73	1	73 - 73
USING OBJECTS ON CUE	90	3	74 - 100
IDENTIFYING BODY PARTS	96	1	96 - 96
IDENTIFYING EASILY HANDLED OBJECTS	94.33	3	85 - 100
IDENTIFYING LARGE OBJECTS	92.66	3	88 - 96
IDENTIFYING PEOPLE	97.50	2	95 - 100
IMITATING WORDS	94	2	88 - 100
PRODUCING SOUNDS ON REQUEST	93.33	3	86 - 100
ATTENDING TO OBJECTS	90	1	90 - 90
FINDING HIDDEN OBJECTS	83	6	73 - 93
FINDING SOURCE OF SOUND	88	3	82 - 94
MATCHING-LEVEL A	87.71	7	78 - 100
SORTING	77	4	70 - 83
IMITATING ACTIONS	96	1	96 - 96
PUTTING OBJECTS IN SEQUENCE	85.54	11	75 - 97
LINING UP OBJECTS	89.57	7	79 - 100
PAIRING EQUAL SETS	91.92	14	75 - 100
SELECTING EQUIVALENT AMOUNTS	91.91	12	78 - 100
MAKING SETS EQUAL	93.20	5	88 - 100
MATCHING EQUAL SETS-1	97	7	93 - 100
MATCHING EQUAL SETS-2	84	1	84 - 84
COUNTING RATIONALLY-1	95	2	94 - 96
NAMING HOW MANY-3	94	1	94 - 94
SELECTING NAMED AMOUNTS-1	94	1	94 - 94
SELECTING NAMED AMOUNTS-4	90	1	90 - 90

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Tables 4 and 5 represent the average percent correct responding for all programs entered into the computer as of the first of this month. You will note that the number of uses for each program is variable, reflecting the heterogenity of the child population. Scanning the range of percent correct responding, you will note that, with a few exceptions, it is quite high; demonstrating to us that public education for the severely developmentally retarded can be a productive effort.

Discussion

This child performance data was collected by teachers trained in the field, in a highly precise instructional technology who followed highly structured instructional programs. The data was collected in 1:1 or small group settings. It represents an unknown proportion of the total instruction received by any student on any given day. On most programs, where children responded to a criterion (4 out of 5 correct responses) data was recorded after every learning trial [task request - response - consequent (reinforcing or correction) event]. Teachers were observed regularly, data was recorded on their program administration skills and where needed, remedial instruction was provided by a trainer with a dual job role. This intensive training and monitoring effort was necessary to enable us to have confidence in our statements about the effectiveness of the curriculum. This procedure also enabled us to specify what teachers learned, and the extent to which they maintained their program administration skills.

We are frequently asked how our system, for teacher training and child instruction, can fit into or survive, in "actual practice". From our perspective, the reverse is the more appropriate question. In the United States, the notion of competency based teacher education has received a great deal of attention. I know of no other way to observe competencies than to specify them, and then go into the actual teaching environment to measure them.

Our primary concern, however, is for the status of public education services for the severely developmentally retarded. As I have noted elsewhere (Tawney 1977b), the concept of equal educational opportunity notwithstanding, the support base for these services is fragile. The conditions which made institutions intolerable for their residents are equally present in public education -- lack of funds, hastily and poorly trained personnel, anonymity within the system, once educational practice is institutionalized. The positive factors which support the present impetus for public education -- massive federal support, legislative authority, parent advocacy, public sympathy -- are all reversible. Thus, from my perspective, instructional systems which produce and document observable and positive change in child performance are a necessary, though not sufficient, condition for continued support for public education for this population.

Implications For The Future

In 1975, I had the opportunity to address a special conference of parents and professionals, funded by BEH and organized by the National Association for Retarded Children. There, describing these materials and technologies, I indicated that they were being prepared for the child of the year 2000 (Tawney, 1975). For, although the curriculum materials are at the publishers now, it will be an extended period before total classroom practice changes to full scale utilization of integrated learning systems.

These types of changes should occur:

1. Increased attention should be given to competency based teacher education, including restructuring of training programs to teach specific skills and evaluate them over an extended period.
2. Computer assisted instruction, for adults, should receive increased support. When content is mobile, teachers may receive instruction in their local school or community. This may facilitate the integration of concepts and practice in the field.
3. University training programs should be modified, and an increased number of persons with specific instructional skills should perform a much more precise level of monitoring and remediation of students.
4. The development of other models of integrated learning systems should be encouraged.
5. Computer data recording and storage systems should be developed to enable teachers to teach and record child behavior at the same time.
6. Systems should be developed for intensive analysis of the quantity and quality of instruction in classes for the severely developmentally retarded. We have begun such an effort. Alternative systems should be encouraged.
7. Classroom evaluation skills should be taught to parents, teachers and other educators so that educational practice can be expanded by persons with different perspectives and interests.

8. Monitoring of public education, as required on an administrative level under Public Law 94-142, should be expanded to allow for intensive effort in the classroom, where education occurs.

9. Alternative uses of computer instruction for children should be continued and expanded.

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